Claims

[c1] 1. A system for design of experiments (DOE) using direct surface manipulation of a mesh model comprising:
a computer system, wherein said computer system includes a memory, a processor, a user input device and a display device;
a computer generated geometric model stored in said memory of said computer system, wherein the model is in a computer-aided design (CAD) format; and
wherein a user using the computer system for a design of experiments on the geometric model converts the CAD model into a mesh model, evaluates the mesh model using a computer-aided engineering (CAE) analysis, modifies a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation of the surface of the mesh model and the updated mesh model is used in the design of experiments.

[c2] 2. A system as set forth in claim 1 wherein the computer system includes a knowledge-based engineering library and the geometric model is stored in the knowledge-based engineering library.

[c3] 3. A system as set forth in claim 1 wherein the computer system uses direct surface manipulation of the surface of the mesh model to parameterize a vertex on the surface of the mesh model within a domain of a DSM feature, determine a displacement of the vertex relative to the DSM feature's maximum displacement using a basis function, and modifying the vertex on the surface of the model by the displacement.

[c4] 4. A method for design of experiments using direct surface manipulation of a mesh model, said method comprising the steps of:
selecting a geometric model, wherein the model is in a computer-aided design (CAD) format;
converting the geometric model into a mesh model;
evaluating the mesh model using a computer-aided engineering (CAE)

analysis;

determining whether to continue generating the design of experiments response;

modifying a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation (DSM), the mesh model is updated and the updated mesh model is used in continuing generating the design of experiments response, if determined to continue generating the design of experiments response; and

using the results of the CAE analysis for the design of experiments.

[c5] 5. A method as set forth in claim 4 wherein said step of evaluating the mesh model using CAE includes using computational fluid dynamics (CFD).

[c6] 6. A method as set forth in claim 4 wherein said step of modifying a surface includes the steps of:

parametizing a vertex on the surface of the mesh model within a domain of a DSM feature;

determining a displacement of the vertex relative to the DSM feature using a mathematical basis function; and

modifying the vertex using the displacement.

[c7] 7. A method as set forth in claim 4 wherein said step of modifying a surface includes the steps of:

defining a sketch plane containing a domain of a DSM feature and positioning the sketch plane relative to the surface of the model;

locating a reference center within the domain;

projecting a vertex located on the surface of the mesh model into the domain of the sketch plane;

specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space;

specifying a basis function to determine a displacement of the vertex;

determining a displacement of the vertex relative to the DSM feature using

the basis function; and

using the displacement of the vertex to modify the surface of the mesh model.

[c8] 8. A method as set forth in claim 7 including the step of selecting a mesh model stored in a memory of the computer system.

[c9] 9. A method as set forth in claim 7 including the step of separating the surface feature modified using DSM from the mesh model and storing the DSM feature within an electronic database in the memory of the computer system.

[c10] 10. A method as set forth in claim 7 including the step of modifying the deformation of a local area of the surface by changing a DSM feature parameter.

[c11] 11. A method as set forth in claim 7 including the step of refining the number of elements of a surface feature modified using DSM.

[c12] 12. A method as set forth in claim 8 wherein said step of selecting a CAD model and converting the CAD model into a mesh model includes the steps of:

selecting a base mesh model from an electronic database stored in the memory of the computer system;

selecting a DSM feature from an electronic database stored in the memory of the computer system; and

generating a mesh model using the base mesh model and the selected DSM feature.

[c13] 13. A method as set forth in claim 8 wherein said step of selecting a CAD model and converting the CAD model into a mesh model includes the steps of selecting a DSM feature from an electronic database stored in the memory of the computer system and generating a mesh model using the converted mesh model and the selected DSM feature.

[c14] 14. A method for design of experiments using direct surface manipulation of a mesh model, said method comprising the steps of:
selecting a base mesh model from an electronic database stored in the memory of the computer system;
selecting a DSM feature from an electronic database stored in the memory of the computer system;
generating a mesh model using the base mesh model and the selected DSM feature;
evaluating the mesh model using a computer-aided engineering (CAE) analysis;
determining whether to continue generating the design of experiments response;
modifying a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation (DSM), the mesh model is updated and the updated mesh model is used in continuing generating the design of experiments response, if determined to continue generating the design of experiments response; and
using the results of the CAE analysis for the design of experiments response.

[c15] 15. A method as set forth in claim 14 wherein said step of evaluating the mesh model using CAE includes using computational fluid dynamics (CFD).

[c16] 16. A method as set forth in claim 14 wherein said step of modifying a surface includes the steps of:
parametizing a vertex on the surface of the model within a domain of a DSM feature;
determining a displacement of the vertex relative to the DSM feature using a mathematical basis function; and
modifying the vertex using the displacement.

[c17] 17. A method as set forth in claim 14 wherein said step of modifying a surface includes the steps of:
defining a sketch plane containing a domain of a DSM feature and

positioning the sketch plane relative to the surface of the model;
locating a reference center within the domain;
projecting a vertex located on the surface of the model into the domain of the sketch plane;
specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space;
specifying a basis function to determine a displacement of the vertex;
determining a displacement of the vertex relative to the DSM feature using the basis function; and
using the displacement of the vertex to modify the surface of the mesh model.

[c18] 18. A method as set forth in claim 14 including the step of separating the surface feature modified using DSM from the mesh model and storing the DSM feature within an electronic database in the memory of the computer system.

[c19] 19. A method as set forth in claim 14 including the step of modifying the deformation of a local area of the surface by changing a DSM feature parameter.

[c20] 20. A method as set forth in claim 14 including the step of refining the number of elements of a surface feature modified using DSM.